FACTS

Ministry of the Environment
Ontario
Hon. Andrew S. B
Minister
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Deputy Minister

ABOUT ACIDIC PRECIPITATION JUNE, 1984

PARRY SOUND DISTRICT

Background

One of the most pressing environmental problems facing large areas of North America is acidic precipitation. All of southern Ontario receives a steady bombardment of acids, acid forming gases and associated pollutants. The acids come down with rain, snow, fog, and small particles in the air.

The large majority of these acids are due to man's activities. Smelters and coal-fired electric generating stations both in Canada and the United States spew millions of tons of sulphur dioxide into the atmosphere annually. Cars, trucks, and trains contribute more millions of tons of nitrogen oxides. These gases react with sunlight, oxygen, ozone, water and other gases to form sulphuric and nitric acids -- strong, corrosive, mineral acids.

In unpolluted areas, rain and snow are naturally slightly acidic since carbon dioxide is a natural component of the atmosphere, and dissolves in water to form weak carbonic acid. Water quality of lakes has developed in response to weathering processes induced by this weak acid. Rocks and minerals react with carbonic acid to form bicarbonate, which is found in natural waters everywhere.

Similarly, the complex biological communities in lakes, streams and forests have adapted and evolved in equilibrium with these natural conditions and processes. However, acid rain has seriously disturbed this equilibrium.

Levels of Acidity

The acidity of a solution is measured on a pH scale. The pH scale is termed logarithmic. This means that a change of one unit on the pH scale corresponds to a tenfold increase or decrease in acidity. Thus, a solution with a pH of 4 is ten times more acidic than a solution of pH 5, and one hundred times more acidic than a solution with a pH of 6.

Distilled water is considered to be neither acidic or alkaline, and has a pH of 7. The carbon dioxide in the atmosphere will cause rain to have a pH of about 5.6 if no other factors are affecting the pH.

Rainfall with a pH less than 5.6 is termed "acid rain", but significant amounts of acid are also deposited as gases and particles through processes called "dry deposition". Current measurements of acids in rain or snow represent only about half of the total amount of acid falling on southern Ontario.

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In the Parry Sound area of Ontario, the average pH of precipitation is less than 4.2, which is 25 times more acidic than normal. Often, individual rain or snow storms have a much lower pH. During the winter of 1983-84, snow events with pH as low as 3.4 were measured at the Ministry of the Environment's Research Centre near Dorset. A pH of 3.4 represents an acid level 160 times that of normal rain.

Survey of Lakes

Most lakes have the ability to neutralize a certain amount of acid. This neutralizing capacity of a lake is measured by the level of bicarbonate alkalinity in the water. If a lake has a high alkalinity level, it can resist pH changes caused by acid inputs. Lakes with low alkalinities can experience pH depressions during spring snowmelt or after heavy rains, times when large acid loads enter the lakes.

A lake with zero or less alkalinity is an acid lake. A negative reading of alkalinity means that the lake contains mineral acidity. These lakes usually have a pH less than 5, and if they have any fish at all, it will be a hardy, acid-tolerant species like yellow perch. Bass and trout species will probably not reproduce, although some adult fish may still survive until they die of old age or other causes.

The neutralizing capacity of a lake is dependent on a number of factors. Lakes in limestone regions usually have a very high alkalinity, since bicarbonate alkalinity results as limestone slowly dissolves. Alkalinity can also be generated in soils, so that groundwater and soil runoff inputs to some lakes can be an important supply of neutralizing capacity.

The Parry Sound District is almost entirely on the Canadian Shield. This region is underlain by granite, and has many exposed rock outcrops. Granite is very insoluble and can supply little alkalinity. The soils are usually shallow and sandy or acidic. These acidic soils are not the result of acid deposition, but are formed by the decomposition of organic material such as forest litter. However, these naturally acidic soils contribute very little neutralizing capacity to lakes, so that most lakes in Parry Sound District have low alkalinity levels.

The Ministry of the Environment in cooperation with the Ministry of Natural Resources conducts lake surveys to determine the sensitivity of these lakes to acidic precipitation. This program is continuing with 4,016 lakes sampled province-wide to date. Of these, 193 are in the Parry Sound District. Lakes are classified by their alkalinity level, and the percentage of lakes in each category is displayed in Table 1. A listing of individual lakes and their rating from 1 (acidified) to 5 (not sensitive) can be found at the back of this fact sheet.

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Table 1

Percentage of Parry Sound District Lakes in Alkalinity Classes

Acidified	Extreme Sensitivity	Moderate Sensitivity	Low Sensitivity	No Sensitivity
3.6	25.9	62.7	7.3	0.5

Georgian Bay is not sensitive. The western part of the Bay, from the Bruce Peninsula to Manitoulin Island, is underlain by limestone. This limestone contributes large amounts of alkalinity to Georgian Bay, rendering it not sensitive to acidification.

The results of this survey of Ontario Lakes are published yearly and include the name and alkalinity classification for individual lakes. A copy of this listing can be obtained from the Ontario Ministry of the Environment, Communications Branch.

LAKE LIMING

In July 1981, the Ontario Ministry of the Environment and the Ontario Ministry of Natural Resources embarked on a joint five year experimental program to study lake neutralization. This program to investigate the feasibility of neutralizing acidic surface waters to both protect and rehabilitate lakes which are susceptible to and damaged by acid rain, is now well under way. The study was initiated as part of the Acid Precipitation in Ontario Study (APIOS) and is being coordinated by Booth Aquatic Research, a private company.

In August 1983, 84 metric tonnes of lime were added to Bowland lake, the first of three lakes to be studied in the Ministries' liming experiments. The approximate cost of liming Bowland Lake was $30,000. The results of this experiment will provide invaluable information for the neutralizing experiments to be done on the other two lakes in the program. Bowland lake was monitored carefully for a full year before the liming was undertaken, to provide information about lake chemistry and behaviour.

At Bowland lake, careful monitoring of pH fluctuations, metal levels and populations of aquatic plants and animals was conducted. Both the MOE and MNR are committed to restoring a natural ecological community in each lake being studied.

In May 1984, Environment Ontario scientists sprayed Trout Lake, north of Parry Sound, with 150 tonnes of limestone at a cost of about $70,000 as part of its research war against acid rain.

Trout Lake is about four times the volume of Bowland lake (35 million cubic metres as opposed to 8.3 million c.m. in Bowland Lake), but its waters are in much better condition. It was still able to support a trout population, whereas trout have been absent from Bowland Lake because of acidification for at least 20 years.

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For the liming, rainbow trout and lake trout were put into a small bay in Trout Lake so that the adjustment of fish to the chemical change in the water could be monitored.

In this experiment, finely ground limestone ($CaCO_3$) was used to promote quick dissolution in the water. Since the limestone has the consistency of talcum powder, it had to be mixed with water, to form a slurry of about 70% limestone and 30% water. Otherwise too much would be carried away by the wind before it reached the lake.

The limestone was delivered to Georgian Bay airport in special containers. It was then blown from these containers into a mixing tank where it was mixed with water to form a slurry. Then it was pumped into the hold of the water bomber which was being used to lime the lake. Because of the large volume of slurry, the liming procedure took about 10 days.

After a lake is limed, it is intensively studied for the next few years. Monitoring of pH levels and aquatic life is continuing on Bowland Lake which was limed last summer. A re-characterization study of Trout Lake over the next two years will follow the liming.

Lake liming is not a permanent solution to the acid rain problem. The water quality in Trout and Bowland Lakes will gradually deteriorate unless the inputs of acid are stopped. The use of lake liming is being explored only as a possible technique for preserving our aquatic resources until acid-forming emissions can be brought under control.

Effects on Fish

It is not simply high acid levels that cause fish death in acid lakes and streams. One well-known property of acids is their ability to dissolve metals. This occurs on a large scale in areas subjected to acidic deposition. Metals such as calcium and magnesium are leached out of soils by acid rain. This removes essential plant nutrients from the watershed. As far as fish are concerned, leaching of aluminum from soils and rocks is far more important.

Granite contains large amounts of aluminum. As the pH of water that contacts granite falls below 5.5, it dissolves the aluminum in increasing amounts. This combination of high aluminum and high acidity is more lethal to fish than high acid levels alone.

Much of the research in Ontario on the effects of acid rain is conducted at the Ministry of the Environment's Dorset Field Research Centre. One study examines the toxicity of acid and aluminum combinations on different life stages of various fish species.

In both laboratory and field experiments, eggs and fish fry of several species of sport fish have been tested. In general, fish eggs are quite tolerant of high acid and aluminium levels. Once the fry emerge from the eggs, however, they are very sensitive. In some streams near Dorset, 100% mortality in exposed fish fry can be observed during spring snowmelt.

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Acids accumulate all winter in the snow pack. When spring arrives, this acid load is released over a fairly short period of time. Even in lakes and streams that have significant neutralizing capacity throughout the rest of the year, this spring input of acid can be overwhelming. The result is a drastic drop in pH, and a pulse of high aluminum concentration. Depending on the time of the melt, this can coincide with the time of year when fish eggs are hatching. If they emerge into this lethal solution, the loss of an entire year class of fish can result.

Biologists can determine the age of fish by counting annular rings in their scales. When a survey of a fish population reveals one or more missing year classes, it is often the first clue that the lake is being acidified. If conditions deteriorate, and successful reproduction does not occur for a number of consecutive years, the population is doomed to extinction.

Effects on Other Aquatic Organisms

Fish are by no means the only inhabitants of freshwater lakes and streams. They are the top link in a complex food chain based on plants and algae, including aquatic insects, crayfish, snails, clams, and a bewildering variety of plankton species. Scientists have found that acidic deposition affects virtually all of these.

Crayfish and clams need calcium to form their hard exteriors. In acidic water, where calcium is much more soluble, they have difficulty forming their protective shells.

Aquatic insect communities are very sensitive to acidification. Mayflies disappear from streams with a pH less than 6. Other insects disappear at lower pH. Unfortunately, black flies and mosquitoes are not among them. Certain species of black fly seem to thrive at low pH, so respite from these pests cannot be hoped for from acid rain.

These sensitive indicators already say that much of the Parry Sound District environment is acid stressed. Species that should occupy streams and lakes are missing, and their place has been taken by acid tolerant species. One popular misconception is that an acid lake or stream is a dead lake or stream. Nature is versatile, and life forms can be found everywhere from volcanic vents to the arctic ice cap. Abundant life can be found in acid lakes, but it is not the kind of life we are used to. Fish, molluscs, and crayfish are gone, but mats of slimy algae can abound.

Acidic conditions can also favour some other distinctly unpleasant life. One type of algae can produce a very disagreeable "rotting cabbage" or "garbage dump" odour. This phenomenon is new: it was first recorded in Haliburton six years ago, and has now been observed in four lakes in Ontario as well as lakes in New Hampshire and Massachusetts. The lakes all have fairly low pH, and are in regions of high acid deposition.

Some amphibian species are also sensitive to acidic conditions. Salamanders, toads, and frogs lay their eggs in water during the spring. Some pools that they use for egg-laying are melt water, and can have low pH and high aluminum levels. Research at Dorset has shown that these conditions can significantly reduce hatching success of their eggs.

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Low pH Drinking Water Supplies

Low pH or high levels of acidity in a water supply can make the water quite corrosive. This means that if the water is left in contact with metal plumbing, some of the metals can be dissolved out of the pipes and solder, resulting in high concentrations of metals in drinking water. These metals (copper, zinc, aluminum and lead) can occasionally exceed health criteria for drinking water, but there is a relatively simple method for solving the problem. The elevated metal levels occur only in water which has been in contact with the plumbing for a number of hours or days. If the hot and cold water systems are flushed by turning on the taps for about one minute or so, the metals drop rapidly to acceptable levels.

In a survey of wells in the Muskoka-Haliburton-Parry Sound area, about 12% had a pH below 6. In general, these low pH wells were quite shallow (less than 40 feet deep) and in sandy soil. A shallow well does not necessarily mean that it will have a low pH though. It should also be noted that the low pH water in these wells does not arise from acidic precipitation. Chemists can determine the type of acid that cause low pH, and in the case of groundwater, the acidity is the result of natural carbonic acid (dissolved carbon dioxide).

Similar problems associated with the leaching of metals from metal plumbing systems can arise in the case of a cottage drawing water from a lake with a low pH. Again, the problem can be averted by thoroughly flushing the plumbing system before using the water.

Heavy Metal and Other Air Pollutants

While acidic precipitation has received most media attention, acid is only one component of a dilute industrial soup raining down on the Parry Sound District. Volatile organics, ozone, and heavy metals are also parts of an air pollution zone covering all of southern and central Ontario.

A core of undisturbed lake sediment yields an historical record of man's activities in Ontario. Presence and absence of different types of pollen can be related to the logging out of the original forests, and introduction of crops and other plants. Towards the upper layers, more sinister benchmarks of man's activities occur: a stratum of radioactive isotopes from atmospheric tests of nuclear devices, and increasing levels of toxic heavy metals.

Low pH in lakes favours the accumulation of these heavy metals in the food chain. Fish taken from low pH lakes have elevated levels of mercury, cadmium, and lead.

Other air pollutants also make their presence felt. Up to $23 million a year may be lost in southern Ontario due to lost crop production because of ozone damage alone.

Air Pollution and Forests

Trees can die from a large number of causes. Drought, insects, fungi, diseases, root damage, road salt, and severe winters can all take their toll. Air pollution can also cause or contribute to the death of trees.

Over the past three to five years, there have been reports from central Europe and Southern Scandinavia on a widespread death and damage of forests. Similar reports from the eastern United States indicate that tree growth is being impaired for unknown reasons. One possibility that is receiving serious study is the link between forest decline or death and air pollution.

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In Ontario and Quebec, there have been reports in Parry Sound of recent dieback of sugar maples. While tent caterpillar infestations in the late 1970's provide at least some of the explanation for this dieback, the Ministry of the Environment, in cooperation with the Ministry of Agriculture and Food, will be undertaking a more thorough assessment of the problem.

What's Being Done

The Ontario Government began the establishment of a province-wide network of air quality monitoring instruments in 1968, and this network has been expanded over the years. The network now consists of more than 1,400 instruments which measure 30 contaminants, including SO_2, NO_x, suspended particulate matter and ozone, with standards and desirable criteria much more stringent than those in other jurisdictions, such as the United States. Under the Ministry's program of air pollution control, industry in the Province has spent more than $1 billion for air pollution abatement. This has resulted in great improvement in the air quality of Ontario cities.

However, more recently when acidic precipitation studies demonstrated that a major share of the precursor pollutants are the result of long range transport, it was realized that airsheds can no longer be considered as an entity with localized boundaries. Since "airsheds" are common to many states and provinces in the U.S. and Canada, pollution control to protect the environment and health of people must be a shared responsibility and commitment of all parties in the common airshed.

Ontario has recognized that it is part of the problem, and must be part of the solution, and therefore has reacted positively by requiring a significant reduction in emissions from the two largest sources of SO_2 in Ontario, which account for 70% of its total emissions.

Inco Limited, the world's largest nickel producer in Sudbury, generally acknowledged to be the largest single point source of sulphur emissions in North America, had cut emissions by about one-half during the 70's. In May 1980, knowing that tougher controls were needed, the Ontario Government ordered Inco to cut back a further 25 per cent by the end of 1982.

The Falconbridge smelter in Sudbury now removes 82 per cent of the sulphur from its ores.

Ontario Hydro, whose combined coal-fired plants form the second largest source of SO_2 in the province, is now under government regulation to reduce emissions by approximately 43 per cent from current average levels by 1990. Hydro is required to meet the established levels regardless of demand for export of power.

In March 1984, Ontario agreed to reduce sulphur dioxide even further. Under a joint federal-provincial agreement, sulphur dioxide emissions in all of Eastern Canada will be reduced from 1980 levels by 50% by 1994. Still this won't be enough.

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In Parry Sound District, over half of the acid deposition comes from sources in the United States. Environment Ontario has taken a vigorous role in trying to promote controls on American sources of pollution. The Province has appeared at numerous hearings to protest relaxations in sulphur dioxide emission regulations. The scientific research carried out by the Ministries of Environment and Natural Resources has been presented at a number of conferences. The evidence of environmental degradation obtained from this research has been instrumental in convincing the American scientific community of the need for sulphur emission controls. Some members (e.g. New York) of the American scientific community were already convinced.

Ontario is totally committed to winning the fight against acid rain, and is deeply concerned by the inaction of the current Administration in the United States in controlling sulphur emissions. This is not a problem that can be solved by pollution abatement in Ontario or eastern Canada alone. Ontario will continue to use every means at its disposal to bring about action south of the border.

For further information, write:

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Parry Sound District

Ahmic (3)
Arthur's (3)
Axe (2)
Bacon (2)
Bair (3)
Barton (3)
Bay (3)
Bear (2)
Beatty (Wolfe) (3)
Beaver (4)
(Mowat Tp)
Beaver (3)
(Croft Tp)
Bell (3)
Bells (3)
Bernard (3)
Big (3)
Birch (3)
Black (1)
Blackstone (3)
Blackstone Harbour (3)
Blackwater (3)
Blue (2)
Bolger(2)
Bray (3)
Bround (2)
Brush (2)
Byrne (4)
Buck (McCann) (2)
(Proudfoot Tp)
Buck (2)
(McMurrich Tp)
Canoe (2)
Cantin (4)
Caribou (3)
Carruthers (2)
Cecebe (3)
Clear (3)
(Conger Tp)
Clear (3)
(Foley Tp)
Clear (2)
(Humphrey Tp)
Clear (3)
(Perry Tp)
Cole (3)
Commanda (3)
Cowper (Spider) (3)
Crane (3)
Creswicke (2)
Deer (2)
(Armour/Perry Tps)
Deer (3)
(Lount Tp)
Diamond (2)
Doe (3)
Dogfish (2)
Dollars (3)

Eagle (3)
Fairholme (3)
Fifteen (3)
First (3)
Flaxman (2)
Fogal (1)
Foote (3)
Forest (3)
Forget (3)
Fowke (Spring) (4)
Gooseneck (3)
Gordon (3)
Green Bass (3)
Grundy (4)
Gurd (4)
Gut (4)
Haines (3)
Harris (3)
Hassard (3)
Healey (2)
Hellangone (3)
Hooton (3)
Horn (2)
(Monteith Tp)
Horn (3)
(Chapman/Ryerson Tps)
Horseshoe (3)
Hutcheson (2)
Isabella (3)
Island (3)
(Proudfoot Tp)
Island (2)
(Wilson Tp)
Jack (2)
Joseph, L. (2)
Kapikog (3)
Kashegaba (3)
Kawigamog (3)
Keiller (3)
King (1)
Kingshott (3)
Krapek (1)
La Force (3)
Lane (2)
Limestone (4)
Lingen (2)
Lioness (3)
Little Blackstone (3)
Little Joseph (3)
Long (Lingen) (2)
Long (Oliphant) (2)
Lorimer (3)
Loucks (1)
Maeck (2)
Magnetawan River (3)
Manitouwabing (3)
Many Islands, L. of (4)
Maple (3)

McCann (2)
McCoy (2)
McDonald (3)
McKechnie (3)
McKellar (4)
McNutt (3)
McQuaby (2)
McQuillan (2)
Memesagamesing (3)
Mill (3)
Milton (3)
Mirage (3)
Miskokway (2)
Morgan Bay (Rosseau) (3)
Naiscoot (2)
Napken (2)
Nine Mile (3)
Nisbet (4)
Noganosh (3)
Oastler (3)
Oldfield (2)
Old Mans (3)
Oliphant (2)
One Island (2)
Otter (3)
Pakeshkag (4)
Parry Island (3)
(Three Mile)
Partridge (3)
Payne (3)
Peanut (3)
Pender (3)
Perbeth (3)
Perch (3)
Pickerel (3)
Pickerel River (3)
Pickering (3)
Plate (3)
Portage (3)
Pringle (3)
Rainy (3)
Rankin (3)
Restoule (3)
Richard (3)
Richmond (4)
Roberts (2)
Rock Island (3)
Roma (2)
Round (1)
Ruth (3)
Rye (Pickerel) (3)
Salmon (2)
Sand (3)
Schmeiler (2)
Scott (2)
Seagull (De Bernard) (3)
Second (3)
Seguin River (3)

Parry Sound District (continued)

Shawanaga River (3)
Shebeshekong (3)
Silver (Tiffen) (3)
Six Mile (Naiscoot) (2)
Smoky (3)
Smyth (2)
Snowshoe (3)
Sollman (2)
Spence (3)
Spider (2)
Skidway (1)
Star (3)
Storm (3)
Sturgeon Bay (5)
Sucker (3)
Sugar (2)
Swan (3)
Tatai (3)
Third (3)
Three Legged (2)
Trout (3)
(McDougall Tp)
Trout (Purcell) (3)
(Humphrey Tp)
Trout (2)
(East Burpee Tp)
Turtle (3)
Virtue (3)
Wahwashkesh (3)
Wauquimakog (3)
Whalley (3)
Whitefish (3)
Whitestone (3)
Wilson (4)
Windfall (3)
Windy (3)
Wood's Bay (3)